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ABSTRACT

This study developed and formatively evaluated an instructional design theory to guide designers in selecting when and how to utilize interactions as instructional methods in a Web-based distance learning higher education environment. Research questions asked: What are the types and outcomes of interactions between participants in a Web-based learning environment? and When and how should these various interactions be designed into a Web-based learning environment? Phase one of the research methodology involved construction of the new instructional design theory. Procedures of phase one included: define the purpose of the theory; define the values of the theory; determine the specific domain, situation, or scope of the theory; identify an optimal participant interaction process on which to model the theory; determine goals/outcomes; develop methods, strategies and tactics; and determine conditions/situations. Phase two of the study involved formative research of the theory. Formative research was done by a review of the literature, expert evaluation, and through a field trial. Findings are discussed in terms of the following interactions: learner to self; learner to learner; learner to instructor; and learner to resources. The findings showed that the adult learners appreciated the variety of assignments and the sense of learner control provided by a balance between flexibility and structure of the course. The provision of instruction relevant to the prior experiences and knowledge of these adult learners also played a great role in fostering interactions. Given the appropriate guidance and support, the learners preferred to work in teams. When the experience was positive, it established a sense of community and enabled a deeper level of situated cognition. (Contains 26 references.) (AEF)

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An Instructional Design Theory for Interactions in Web-based Learning Environments

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Introduction

Universities across the country are offering a growing number of courses on the World Wide Web. Many faculty and instructors are now faced with the challenge of teaching at a distance in a Web-based environment and are collaborating with instructional designers on how to effectively design Web-based distance education courses.

Teaching at a distance requires different strategies than those used in a traditional teaching environment. In traditional classes, interactions between learner and instructor and among all learners in a class are mostly synchronous. Often a lack of interaction has been considered a major weakness of distance education, blamed for causing feelings of isolation in learners who are situated all over the world with no or minimal face to face contact. Interaction between the learner and the course materials and resources can be hindered by new and unfamiliar technology. Nontraditional learners taking courses on the Web may not have the self-regulation or study skills to perform well in this environment. Interactions on each of these levels have been identified as a critical component for successful online learning (Hirumi & Bermudez, 1996; Moore, 1989; Roblyer & Ekhaml, 2000; Schrum & Berge, 1997; Vrasidas & McIsaac, 1999; Wagner, 1994), yet it can be extremely difficult for instructors to foster interactions in a distance environment.

Much of the literature regarding interactions in distance education has focused on the development and use of technology tools that permit interactivity or have focused on interactions as if they are the outcomes of instruction rather than the methods of instruction as pointed out by Wagner (1997). Little research has focused on interactions as instructional methods rather than outcomes.

An instructional design (ID) theory is a "theory that offers explicit guidance on how to better help people learn and develop" (Reigeluth, 1999). ID theories are prescriptive and design-oriented, identifying methods of instruction (including instructional strategies and tactics) and the situations in which these methods should and should not be used, based on the instructional conditions and desired outcomes.

The current study developed and formatively evaluated an instructional design theory to guide designers in selecting when and how to utilize interactions as instructional methods in a Web-based distance learning higher education environment.

Research Questions

1. What are the types and outcomes of interactions between participants in a Web-based learning environment?
2. When and how should these various interactions be designed into a Web-based learning environment?

Methods: Phase 1

Construction of New Instructional Design Theory

Phase 1 of the research methodology involved construction of the new instructional design theory. A type of formative research methodology, as described by Reigeluth and Frick (1999), was used to create and test this new instructional design theory. Specifically, we designed a particular case in which to develop the new theory. We chose an instructional situation (a Web-based graduate course) that we wanted our theory of interaction to apply to, helped to design the case (the course), and developed a tentative design theory in parallel. The case, therefore, became an instance of the theory.

The designed case was that of a Web-based distance graduate course in educational psychology at a large Midwestern university. The course is required for many programs in the school of education. The course is run entirely through a course management system on the Web. Both researchers were involved in the course design process, as recommended by Reigeluth and Frick (1999). By participating in the course design, it fosters "intimate familiarity with the case [which] is essential for developing good grounded theory" (p. 644). The design theory was developed in parallel with the course.

A five-member design team, including both the instructor and associate instructor, met once a week for approximately three months to design and develop the course. The researchers documented the design decisions and rationales as they developed the theory. This included documentation of intended learning outcomes; selection of methods, strategies and tactics; documentation of situationalities which influenced design decisions; and identification of the values behind instructional decisions.

The overall learning outcomes for this graduate course were for students:

- To become conversant with the basic assumptions, concepts and principles of each learning theory
- To determine the possible implications of each theory for instructional settings
- To be able to compare and contrast theories and their usefulness in the various settings of interest to the students in the course and other education professionals

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- To create and revise a personal theory of learning

Throughout the design of the graduate course, we consistently documented our rationales for the selection of particular methods for particular learning outcomes, particularly as they related to use of interaction methods. We referred to the design notes to identify what the intended outcomes were for the method and extrapolated the instructional conditions and instructional outcomes.

The following procedure was used (Reigeluth, 1983; Nelson, 1998) to develop the theory in tandem with the designed case study:

Define the Purpose of the Theory

The purpose of this theory is to provide guidance for designers of Web-based graduate courses on when and how to utilize learner to learner, learner to instructor, and learner to resource and learner to self-interactions as instructional methods. Interactions as an instructional method contribute to the outcomes of the instruction such as team building, clarifying understanding, supporting learner control and enhancing elaboration and retention (Wagner, 1997).

Define the Values of the Theory

According to Reigeluth (1999), values "guide selection of goals and selection of methods" (p. 12). The values that guide this theory include:

- A belief that adults are most motivated to learn when they feel success, volition, value and enjoyment
- Higher-order thinking skills and complex cognitive tasks are best fostered by interacting with other learners to socially construct meaning
- Instruction should provide variety
- Instruction should foster creativity
- Instruction should be authentic and relevant to learners' lives
- Instruction be related to previous experiences and linked to prior knowledge
- Resources should be available to help learners with their tasks
- Activities should build on previous work done in the course
- Instruction should provide social as well as cognitive support
- All learners should have the chance to participate
- Cognitive overload should be avoided
- Learners should have responsibility for their own learning

Determine the Specific Domain, Situation or Scope of the Theory.

This theory addresses learning in the cognitive domain. It is applicable to learning situations with adult learners in higher education settings, particularly Web-based learning environments. The scope of the theory is specifically to provide guidance on when and how to utilize interactions as instructional methods that can be used effectively to attain cognitive outcomes.

Identify an Optimal Participant Interaction Process on which to Model the Theory.

The development of an optimal participant interaction process used in this study is based on previous experience of the researchers both as students and as researchers. This serves as a framework for the synthesis of the review of the relevant literature. The review of the literature can be seen as an initial formative research of the developing theory.

Moore (1993) points out that distance education is not simply a geographic separation of learners and teachers, but more importantly, a pedagogical concept. It is a concept describing the universe of teacher-learner relationships that exist when learners and instructors are separated by space and /or by time (Moore, 1993). From this separation, special patterns of learner and teacher behaviors that affect both teaching and learning are formed. The psychological and communications space of potential misunderstanding between the learners and instructors is called the transactional distance. The three sets of variables, which define the extent of transactional distance in an educational environment, are dialogue, structure and learner autonomy. 'Dialogue' can be translated as interaction, which places value on the synergistic nature of relationship of the involved participants (Moore, 1993). Based on this theory, interactions are even more important in distance environments than in residential environments, as when participant are separated by space and time the transactional distance is more difficult to overcome.

Vygotsky's (1978) understanding of learning as a social process is also critical to the discussion of distance learning theories. Various technologies and tools used for distance education create the context and setting where learning can occur. In Vygotsky's concept of the Zone of Proximal Development (ZPD), social interaction is crucial to the development of the new patterns of thoughts and behaviors.

The tools and signs the learner is exposed to play a great part in influencing or mediating the new patterns of thought and mental functioning (Werstch, 1991). Under the socio-cultural framework, what is meant by knowledge and learning is a change in perspective. If meaning must be personally constructed, then the learner is central to the learning process because personal experience determines reality. Hence, there is a need to consider instructional design from a more learner-centered perspective. Bonk and Cunningham (1998) incorporated the framework of sociocultural theory and principles for computer-supported collaborative learning (CSCL) environments. Compared to the cognitive constructivists' focus on making learning more relevant and building on students' prior knowledge, social constructivists emphasize human dialogue, interaction, negotiation, and

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collaboration (Bonk, Oyer & Medury, 1995). It is argued that social interaction and dialogue is central to learning. New skills and strategies first appear in a social place with adults and more capable peers in one's learning environment and are later internalized (Bonk, Appleman & Hay, 1996).

Thus, interactions among others in the learning environment are important to the learning process. Interaction itself can be defined as "sustained, two-way communication among two or more persons for purposes of explaining and challenging perspectives" (Garrison, 1993, p.16) or as "two-way communication among two or more people within a learning context, with the purposes as either task/instructional completion or social relationships building" (Gilbert & Moore, 1998).

Moore (1989) distinguishes three types of interaction in distance education: 1) Learner-content interaction. The learners are constructing knowledge through a process of accommodating new understanding into their cognitive structure; such interaction with content is one way to restructure knowledge. 2) Learner-instructor interaction relates to the assistance, counsel, organization, stimulation and support that the instructor provides to the learner in constructing new understanding of the content. 3) Learner-learner interaction is a kind of "interaction between one learner and other learners, alone or in group settings, with or without the real-time presence of an instructor" (Soo & Bonk, 1998).

In addition to the three types of interaction identified by Moore (1989), many researchers emphasize learner- to-self interaction as a fourth very important component in learning: 4) Learner-self interaction: participating in an internal dialogue with oneself. While some researchers emphasize the importance of learner-learner interaction, minimizing the importance of the time allocated to self-reflection during online education (Soo & Bonk, 1998), others note the importance of the inner-dialogue system, suggesting that the development of self-regulatory skills is vital to independent learning and instruction (Savery & Duffy, 1996).

All four types of interaction are vital for distance education, although each type may be most appropriate for different tasks and for learners at different stages of development (Moore & Kearsley, 1996.) An instructional design theory can help us make this determination.

Based on the literature it is clear that interactions have instructional value and that there are many ways of fostering such interactions in distance education environments. However, this literature falls short of being *prescriptive* in nature because little attention is paid to the situationalities in which the methods may be more or less effective. Nor does the literature address the relationship between the various types of interactions and outcomes. Thus our theory will focus on addressing situationalities in which the methods are best used.

Determine Goals/Outcomes.

Wagner (1997) identified thirteen outcomes of interactions that are relevant to the design of this theory. These include:

- To increase participation and engagement with the learning process
- To increase social engagement with others in the group. To develop communication. To receive feedback
- To enhance elaboration and retention
- To support learner control/self-regulation
- To increase motivation
- To negotiate understanding. To build a team
- To discover
- To explore. To clarify understanding intended
- To gain closure

The development of our theory included an investigation of how these various outcomes were attained through the four types of interactions.

Develop Methods, Strategies and Tactics.

This theory focuses on the use of four methods of interactions: learner to learner, learner to instructor, learner to content and learner to self.

Determine Conditions/Situations.

Situations are "aspects of the instructional context that influence selection of methods" (Reigeluth, 1999, p.8). If any element of the situation changes, the instructional methods may need to be changed as well. Situations have two parts: instructional conditions and the desired outcomes of instruction. Instructional conditions include the nature of what is to be learned (learning outcomes), the nature of learner, the nature of the learning environment, and the nature of instructional development constraints.

According to Reigeluth (1999), the desired instructional outcomes include the level of effectiveness (how well learning goals are attained), the level of efficiency (effectiveness divided by cost and time), and the level of appeal (extent to which students enjoy the instruction).

Our findings from the formative research of the theory enabled us to identify in which conditions and situations the methods of interactions worked.

Methods: Phase 2

In Vivo Formative Research for a Designed Case

Phase 2 of the study involved formative research of the theory. Formative research was done by a review of the literature, expert evaluation and through a field trial. A review of the literature was done to support the optimal participant interaction process around which the theory was developed. Expert evaluation of the theory was done by the instructor of the course used as the designed case study. Finally, a field trial was conducted with the course as it was taught during the summer of 2001.

Formative evaluation of the designed case was conducted as a field trial. The purpose of the formative evaluation was to identify and remove problems with the instructional design theory (Reigeluth & Frick, 1999; Thiagarajan, Semmel, & Semmel, 1974). This took place in the summer of 2001 as the course was being taught. An instrumental case study approach (Stake, 1995) was used. Stake describes the purpose of the case examination as being to provide insight into an issue or to redraw a generalization. Though a case study focuses on a single case, the researchers can construct a hypothesis for generalization by close observation of the case. The case plays a supportive role, and it facilitates the researcher's understanding for more general situations.

Course Context

The instructor, an associate professor in the department, and the associate instructor, a doctoral student, participated in the design and development as well as the implementation of the course. This is the first time the instructor and associate instructor had taught a Web-based course. However, both were very familiar with the content of the course, as the instructor had taught the residential version of the course many times. Nineteen graduate students completed the fourteen-week graduate course during a summer session. Among the nineteen students, eight students were part of a cohort group that had begun a Web-based Master's degree program two semesters earlier. Thirteen students had taken distance courses prior to this one.

The fourteen-week course was organized into eight units plus an orientation unit. Each student was required to participate in two team collaborative activities but could choose whether or not to work in teams for additional projects. The maximum number of team activities a student could participate in was five. The students were given seven assignments total: they were allowed to choose to work on the assignments either individually or in a group.

Data Collection

Data for formative evaluation of the course as part of the formative research on the instructional design theory was collected as follows. The researchers informed course participants that a new instructional design theory concerning interactions was being used for the course. This information was distributed by means of the human subjects consent forms used to obtain participant permission to have their online data be used in the study. Sixteen out of the nineteen students in the course agreed to participate in the study.

Data was collected from multiple sources including two Web-based surveys, interviews and observations via document analysis of the course transcripts of communication, learner reflections and completed assignments. The first Web-based survey was distributed after the first half of the course and the second after the conclusion of the course. Telephone interviews were conducted after the conclusion of the course as well. Eleven students completed the first survey and thirteen completed the second. Eight students participated in telephone interviews after the course ended. Both instructors were interviewed half way through the course and again at the end of the course. In addition to the surveys and interviews, transcripts of the discussion forums, class e-mail, course assignments and feedback, learner reflections and chat transcripts from the Web based course were downloaded from the course.

Data Analysis

Data analysis involved data reduction, data display, and conclusion drawing (Reigeluth & Frick, 1999). First, the researchers worked independently to identify themes based on methods and strategies of the instructional design theory. They then categorized these themes by the instructional method or strategy for which it was intended (English, 1992). After closely reading the data, the two researchers reviewed the categorized data to identify which method or strategy had received the most comments. These comments were then examined by both researchers to identify aspects of the method that were receiving comments by the participants.

The findings from the data were then displayed by placing the categorized data into a matrix, which illustrated relevant situational characteristics. Finally, conclusions were drawn regarding specific recommendations for theory improvement.

Findings

Interaction: Learner to Self

In the beginning of the course, the learners were asked to share their expectations of the course, to post an initial personal theory of learning, to identify criteria for usefulness of learning theories and to post initial reactions to general statement about learning. The goals of these activities were to support learner control and self-regulation as well as to activate prior knowledge. The data revealed that these adult learners have rich resources of prior experiences to their learning. These adult learners valued

instruction that is personally relevant to them. It seems to be very important for the instructor to identify the prerequisite skills, knowledge and the needs of individuals before and during the instruction.

As learning activities, learners completed individual as well as team thought activities requiring application of the learning theories to practice. The learners were also asked to participate in whole class discussions on the unit topics. The goals of these activities were for the learners to discover, explore, clarify and negotiate understanding as well as enhancing elaboration and retention. Findings showed that the learners were interested in discussions and assignments that were relevant to their lives and needs.

For reflection on learning, the learners were required to complete self-reflections after each project. They were asked to reflect upon what resources they used to complete the projects and how their understanding changed during the unit activity. At the end of course, learners revised the initial personal theory of learning and instruction from the first week and also participated in a final reflective discussion. These activities supported learner control and self-regulation as well as providing closure. They provided opportunities to create a synthesis framework in which to place the theories and the self-reflections were helpful in fostering metacognitive skill development

Interaction: Learner to Learner

The learners participated in many activities throughout the course building teams and increasing social participation and engagement with learning process. For orientation, an informal icebreaker activity provided a chance for learners to get to know each other. Everyone in class including the instructors was required to post eight nouns that best described themselves. The three most commonly mentioned words in this activity were 1) teacher/educator, 2) learner/student and 3) parent/grandparent. The high frequency of these words revealed the important characteristics of this group of adult learners: many of them were involved in authentic situations of learning and instruction in their everyday lives. The class was also asked to post their personal profiles and digital photographs. This helped building a sense of community.

One of the main activities for fostering learner to learner interaction was collaborative team tasks for the unit assignments. By providing choice in the scheduling of collaborative activities as well as the number of group activities to participate in, the course supported learner control and self-regulation. Because these adult learners had extremely busy schedules, the learners felt that two weeks should be the minimum time frame for collaboration. Having project deadlines on Mondays proved to be helpful for these learners since it provided the weekends for them to complete the tasks. For teamwork, the learners were required to provide feedback on the contribution of team members after the completion of projects. It served the purpose of providing feedback and closure as well as building the sense of a team. For the tools the team used, they used different tools for different purposes. Most used initial chats for the decision making process and found them very useful. Twelve out of 13 students indicated in the second survey that they were satisfied with the amount of student-student interaction in the course. Only eight out of 13 indicated they were satisfied with the amount of student-instructor interaction. Nine out of 13 chose to work in groups again for the second half of the course. Of the four who did not choose to work in groups, two participated in interviews. They indicated that their reason for not working in groups was primarily due to busy work schedules and that they wished they could have participated more in group work.

The learners were also asked to facilitate the whole class discussion by choosing to be either the "facilitator" or the "wrapper" for the unit discussion. This activity increased the engagement with the learning process as well as supporting learner control. Instead of having instructors responding every posting to the discussion, the peer facilitation generated a more student-centered atmosphere. The facilitator role presented a new perspective each week and some of the facilitators took on additional roles in the discussion, such as the devil's advocate, to purposively challenge the peers' statements.

Peer to peer responses were also encouraged throughout the course. The learners were asked to comment regularly on others' postings. Many learners felt the heterogeneity of experiences in the class, the great stories and advice from others' experience was tremendously helpful. They said the multiple perspectives resulted in deeper learning.

Interaction: Learner to Instructor

The primary goals of learner to instructor interaction were to build communication, support learner control and self-regulation, and to provide feedback. They also appreciated instructors periodically checking in on teams' progress and whole class discussion. At times when the topics of whole class discussions would drift away from the theory being discussed, the instructors' guidance and redirection proved to be helpful. Learners also appreciated instructors' participation for the sense of "presence". The learners mentioned that they benefited from instructor feedback that focused both on strengths and areas of improvement. In Web-based environments, where tone is not apparent in writing, increased care is necessary when instructors formulate criticisms.

Interaction: Learner to Resources

Learner to resources interactions were used to present new information, increase engagement with the learning process as well as to support learner control. Because learners access new information at their own pace, they rely heavily on the course Website and resources for all information. In an online environment, it proved to be efficient to provide additional Web-based resources to supplement the text. One of the most important findings was that learners felt that having models or examples of expected work were extremely helpful and they wanted to see more of those. They pointed out that they really liked having examples of good whole-class discussion postings provided at the start of the course. They wanted to have more guidelines for collaborative assignments, more specific grading rubrics and more advice for successful online collaboration. The findings

showed that the instructors should be careful not to make many assumptions regarding "Web-course literacy" on the part of the distance students. More time and effort were required than in residential courses, especially for the first time distance learners.

Conclusion

This study presents the guidelines for when and how the four types of interaction should be used to achieve the various learning outcomes. By providing a deeper understanding of the adult learners in a distance course, this research indicates that the all four types of interaction are important methods of instruction in a Web-based learning environment. The findings showed that the adult learners appreciated the variety of assignments and a sense of learner control provided by a balance between flexibility and structure of the course. Providing instruction relevant to the prior experiences and knowledge of these adult learners also played a great role in fostering interactions. Given the appropriate guidance and support, the learners preferred to work on teams. When the experience was positive, it established a sense of community and enabled a deeper level of situated cognition.

For further research, it would be useful to explore the dynamics of collaborative works in Web-based learning environments: the content and discourse analysis of a successful team's experience as well as criteria for good participation and facilitation in class discussions. Greater insight would be obtained by more detailed exploration of the learning outcomes and methods of evaluation specific to adult learners in Web-based learning environments.

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